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Measurement of the CKM Angle Alpha at the BABAR Detector Using B Meson Decays to Rho Final States

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by

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Abstract

This thesis contains the results of an analysis of $B^0 \to \rho^+\rho^-$ using 232 million $\Upsilon(4S) \to B\overline{B}$ decays collected with the BABAR detector at the $PEP-II$ asymmetric-energy B Factory at SLAC. From a fitted signal yield of 617 ± 52 events, the longitudinal polarizations fraction, f_L, of the decay is measured to be $0.978 \pm 0.014(\text{stat})\,^{+0.021}_{-0.029}(\text{syst})$.

The nearly fully longitudinal dominance of the $B^0 \to \rho^+\rho^-$ decay allows for a measurement of the time dependent CP parameters S_L and C_L, where the first parameter is sensitive to mixing induced CP violation and the second one to direct CP violation. From the same signal yield, these values are found to be $S_L = -0.33 \pm 0.24(\text{stat})^{+0.08}_{-0.14}(\text{syst})$ and $C_L = -0.03 \pm 0.18(\text{stat}) \pm 0.09(\text{syst})$.

The CKM angle α is then determined, using these results and the branching fractions and polarizations of the decays $B^0 \to \rho^0\rho^0$ and $B^+ \to \rho^+\rho^0$. This measurement is done with an isospin analysis, in which a triangle is constructed from the isospin amplitudes of these three decay modes. A χ^2 expression that includes the measured quantities expressed as the lengths of the sides of the isospin triangles is constructed and minimized to determine a confidence level on α. Selecting the solution compatible with the Standard Model, one obtains $\alpha = 100^\circ \pm 13^\circ$.

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